

Patent Claims

1. Method and plant for the extraction and/or encapsulation of living cells from organs, characterized in that the organ containing the cells is disintegrated in an enzymatic process into individual cells and/or cell agglomerations, that the relevant cells are subsequently separated from the cell mixture thus obtained and can then be encapsulated.
2. Method according to claim 1, characterized in that it comprises some or all of the following steps, which can also be repeated several times:
 - flowing a nutrient fluid heated to approximately 35 – 38°C around an organ
 - extracting cells from the organ by means of an enzyme
 - transferring the extracted cells through the nutrient fluid in form of a suspension
 - cooling the cell suspension thus obtained to approximately 3 – 8 °C
 - concentrating the cell suspension by separating the cells from the suspension with a porous frit
 - after the separation of the cells, returning the nutrient fluid into a cycle
 - marking specific cell types in the concentrated suspension by means of magnetically marked antibodies
 - separating the so marked cells from the suspension in a magnetic field
 - suspending the relevant cell fraction in a base material
 - transforming this base material suspension into droplets
 - precipitating the droplets
 - rinsing and suspending the spherules formed by the precipitation in a washing liquid
 - flowing a polycationic polymer solution around the spherules and forming a cationic charge on the surface of the spherules
 - washing the spherules with a washing liquid
 - washing the spherules with a detergent solution
 - flowing a polyanionic polymer solution around the spherules and forming an anionic charge on the surface of the spherules

- rinsing and suspending the spherules formed by the precipitation in a washing liquid
 - suspending the spherules formed by the precipitation with the cells in a cell culture
 - incubating the spherules with the cells
 - freezing the spherules with the cells
 - drying the spherules with the cells.
3. Method according to claim 1 and 2, characterized in that the enzyme used for the cell isolation is a collagenase.
 4. Method according to claim 1 and 3, characterized in that the base material into which the cells are stirred for the encapsulation is a soluble natural material or synthetic material.
 5. Method according to claim 1 to 4, characterized in that the base material is transported into a device for producing droplets by mechanical means, preferably a screw conveyor or a pump.
 6. Method according to claim 1 to 5, characterized in that the base material is transported pneumatically into a device for producing droplets.
 7. Method according to claim 1 to 6, characterized in that the device for producing droplets forms part of a reaction vessel.
 8. Method according to claim 1 to 7, characterized in that the base material is transformed into droplets by vibration, an air flow, a rotational movement (centrifugal forces) and/or by emulsification.
 9. Method according to claims 1 to 8, characterized in that the produced droplets can be precipitated chemically, e.g. by the influence of salts.

10. Method according to claims 1 to 9, characterized in that the produced droplets can be precipitated physically, e.g. by a temperature change.
11. Method according to claims 1 to 10, characterized in that the precipitated droplets contain the living cells extracted from an organ.
12. Method according to claims 1 to 11, characterized in that the precipitated droplets are kept suspended in the precipitating bath.
13. Method according to claims 1 to 12, characterized in that the precipitated droplets are kept suspended in the precipitating bath by stirring.
14. Method according to claims 1 to 13, characterized in that the precipitated droplets are kept suspended in the precipitation bath by the flow rate of the surrounding medium.
15. Method according to claims 1 to 14, characterized in that the precipitated droplets are coated by flowing suitable polymer solutions around them.
16. Method according to claims 1 to 15, characterized in that the precipitated droplets are kept suspended during the coating.
17. Method according to claims 1 to 16, characterized in that the precipitated droplets are kept suspended during the coating by stirring.
18. Method according to claims 1 to 17, characterized in that the precipitated droplets are kept suspended during the coating by the flow rate of the surrounding medium.
19. Method according to claims 1 to 18, characterized in that the coated spherules have an envelope fully enclosing the core and thus the encapsulated material.

20. Method according to claims 1 to 19, characterized in that the envelope of the coated spherules is formed of one or more radially arranged layers.
21. Method according to claims 1 to 20, characterized in that the layers of the envelope may be portions of different density.
22. Method according to claims 1 to 21, characterized in that the coated spherules can be stored and used in an undried, i.e. moist condition.
23. Method according to claims 1 to 22, characterized in that the coated spherules are can be freeze-dried.
24. Method according to claims 1 to 23, characterized in that the coated spherules can be air-dried.
25. Method according to claims 1 to 24, characterized in that solutions applied for precipitation and/or coating are used either as concentrates or ready for use in a diluted form.
26. Plant according to claim 1, which operates according to a method according to claims 1 to 25, characterized in that it comprises some of the following main components:
 - reaction chamber for receiving the organ, comprising a perforated plate and a stirrer (RK)
 - cooling (KT) and heating (HT) thermostat
 - heat exchanger for controlling the temperature of the liquids (WT1, WT2)
 - decantation vessel with porous frit and tubular feedthrough (DK)
 - chamber for separating marked mixtures in the magnetic field (TK)
 - mixing container for the base material and the cells (MI)
 - reservoir for the precipitation bath (VB1)
 - reservoir for the coating solutions (VB2, VB3, etc.)
 - reaction vessel for transforming the base material cell suspension into droplets and precipitating the same (VR)

- device for drying the coated spherules
 - pumps (P1, P2, P3) and valves (V1, V2, ...)
 - corresponding control components
27. Plant according to claims 1 to 26, characterized in that it operates in accordance with Fig. 1 and respectively Fig. 1a and/or that its components are arranged and/or connected to each other in accordance with Fig. 1 and respectively Fig. 1a.
28. Plant according to claims 1 to 27, characterized in that it comprises a cell isolation module operating in accordance with Fig. 2 and/or that the components thereof are arranged and/or connected to each other in accordance with Fig. 2.
29. Plant according to claims 1 to 28, characterized in that it comprises a cell separation module operating in accordance with Fig. 3 and/or that the components thereof are arranged and/or connected to each other in accordance with Fig. 3.
30. Plant according to claims 1 to 29, characterized in that it comprises a cell encapsulation module operating in accordance with Fig. 4 and/or that the components thereof are arranged and/or connected to each other in accordance with Fig. 4.